1. **The Construction and Operation of Nuclear Fuel Rod Reprocessing Plants**:

Spent fuel reprocessing is the recovery of usable plutonium and uranium from spent ("used") nuclear fuel that has been discharged from a nuclear reactor. The non-fuel cladding around the fuel rods is removed, the fuel rods are dissolved in nitric acid, and the reusable uranium and plutonium is separated from the nitric acid solution containing the highly radioactive fission products. These high-level wastes are stored in tanks or, as is done in France, vitrified into glass and stored for eventual disposal in a high-level waste repository. The most widely used method for reprocessing is the PUREX (Plutonium-Uranium Extraction) technology that was initially developed as part of the nuclear weapons development program to recover plutonium from spent fuel to make nuclear bombs.

Up until the mid-1970s the commercial nuclear industry was expected to operate several nuclear fuel reprocessing plants to recover plutonium from spent fuel in US reactors. The recovered plutonium was to be used as mixed oxide fuel (plutonium dioxide and uranium dioxide) in light water reactors and later as fuel for breeder reactors. No long-term storage of spent fuel was planned. However, in 1974 concern about reprocessing was heightened when India tested a nuclear explosive made with plutonium that had been recovered from spent fuel using reprocessing technology provided by the U.S. The U.S. policy on reprocessing was reassessed under President Ford and in 1977 the President Carter Administration decided against licensing the newly built reprocessing plant in Barnwell, South Carolina. This licensing moratorium was reversed under the Reagan Administration, but by that time the high costs associated with commercial reprocessing meant there was no longer any commercial interest in reprocessing in the U.S. In 1993, the Clinton Administration reinstated U.S. opposition to reprocessing. However, the George W. Bush Administration reopened the question about reprocessing and proposed a major new reprocessing initiative called the Global Nuclear Energy Partnership (GNEP).

As reported in the Energy Commission's 2007 Integrated Energy Policy Report (p. 68), significant questions remain regarding reprocessing technologies available today and those that GNEP proposed. A National Academies panel concluded in 2007 that the rationale for the GNEP program was unpersuasive, that the GNEP relied upon technologies that were too early for commercial development (decades away), and too expensive (costing tens of billions of dollars or more). The panel further concluded that GNEP should not go forward at its current pace, has had insufficient independent review, and there are major uncertainties about its ability to address U.S. waste disposal issues. The U.S. General Accountability Office's 2008 assessment of GNEP concluded that the U.S. Department of Energy (DOE) was unlikely to attract enough industry investment in any of the GNEP technologies to avoid the need for a large amount of government expenditures.

France (La Hague), Great Britain (Sellafield) and Japan have reprocessing plants. The first and only reprocessing plant in the U.S. was located at West Valley, New York and operated from 1966 through 1972. It reprocessed a total of 640 tons of spent fuel, which resulting in 660,000 gallons of highly radioactive liquid waste. By 1976 the costs

and regulatory requirements for reprocessing made it commercially impractical and the facility was closed. The liquid high-level waste and decontaminating and decommissioning responsibilities were passed from the state of New York to the Department of Energy. A second reprocessing plant was built in the 1970s at Morris, Illinois incorporating new technology which, although proven on a pilot scale, failed to work successfully at a production scale. A third plant was constructed at Barnwell, South Carolina but never operated due to the Carter Administration policy that ruled out all U.S. civilian reprocessing as part of the U.S. non-nuclear weapons proliferation policy.

The issues identified for reprocessing in the Energy Commission's 2005 report "Nuclear Power in California: Status Report" include: (1) economics (there is substantial consensus, even among nuclear advocates, that reprocessing is not currently economic), (2) operations safety (an MIT study reported that the accident frequency for reprocessing plants is much higher than for nuclear reactors), (3) environmental impacts, and (4) nuclear weapons proliferation (reprocessing produces plutonium that is easily transported and could be used to make a nuclear device).

2. **The permanent disposal of high-level nuclear waste and Yucca Mountain.**

More than 50 years of commercial nuclear energy in the U.S. has generated tens of thousands of tons of highly radioactive waste. Because of the high radioactivity of this waste, it must be isolated from the environment for tens of thousands of years while the radioisotopes decay to safer levels. Although several countries are exploring various long-term disposal options, no country has begun to store spent fuel and high-level waste in permanent repositories. France's high-level waste that is generated from its reprocessing plant in La Hague is vitrified into glass and stored in canisters onsite.

After decades of U.S. efforts to establish a permanent geologic repository for spent nuclear fuel and high-level waste at Yucca Mountain, Nevada, development of this repository was halted in 2010. This program had long been challenged by scientific and technical uncertainties about the site's suitability for isolating the wastes from the environment and legal and political challenges. The Yucca site failed two of the four criteria established by the International Atomic Energy Agency for permanent repositories: it is located in a tectonically active area and is in a reducing (not oxidizing) geochemical environment. The result would be that a repository, if built at Yucca Mountain, would require engineering fixes and there would be considerable uncertainty about the long-term performance of the repository.

In the 2005 Integrated Energy Policy Report the Energy Commission reaffirmed its findings made in 1978 that "a high-level waste disposal technology has been neither demonstrated nor approved." The report also found that "reprocessing remains substantially more expensive than waste storage and disposal and has substantial adverse implications for the United States effort to halt the proliferation of nuclear weapons."

Halting development of the Yucca Mountain repository means that the federal government has no clear policy in place for the permanent disposal of nuclear waste from reactors. Possible options include extended dry cask storage at reactor sites or at a few centralized storage facilities and/or the development of commercial reprocessing.

In 2009, the Obama Administration established the Blue Ribbon Commission on America's Nuclear Future to investigate such alternative solutions and make recommendations to the Administration. This panel of experts is conducting a comprehensive review of the policies for managing the back end of the nuclear fuel cycle, including alternatives for storing, reprocessing and disposal of spent nuclear fuel and high-level waste. The Commission will release a draft report in Summer 2011 and a final report in December 2011.